## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

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# SALTS IN IRRIGATION AGRICULTURE

by

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Salts and salt-affected soils are the major problems of irrigation. Much irrigated land is going out of production every year because of the effects of salt. No simple approach to the problems is adequate, since salts in irrigation water, in soils and in underlying strata all require detailed study, along with that of inherent properties of soils and deeper horizons, tolerances of plants and animals to salts and the whole water regime of the area. Complex situations involving water, soil, plant and animal need to be understood.

The well-known adverse influence of sodium colloid on permeability of soil gave strong emphasis towards the evaluation of irrigation waters in terms of their tendencies to induce sodicity in the soil clay. Systems which classify irrigation waters on this factor along with total salinity, content of boron and so on are valuable tools, but there is a tendency to lose sight of the limitations imposed by other factors. Paramount among these is drainage.

The useful concept of "leaching requirement" clearly is not applicable if sufficient underdrainage to attain adequate leaching from the root zone is not available. Whatever they might do to the soil colloid, salts of any kind in sufficient concentration on the soil solution in the root zone act adversely on plants by osmotic effects and by direct toxicity of certain ions. Lithium and boron are dangerous even at very low concentrations. Great care in reuse of drainage waters for irrigation is needed when such elements are present. Fluorides and salts of molybdenum and selenium may harm animals fed on forage grown on water-soil systems containing them. For leaching, for reclamation, for plant protection, underdrainage must be such that water from irrigation or rain can percolate through the soil at a rate sufficient to satisfy the aeration requirements of plant roots and a quantity sufficient to maintain salts in the root zone below the concentration conforming with the salt tolerance of the particular crop.

Recently there has been a new emphasis on the flocculating effects of salts in soil water on soil colloids rather than on the sodium hazards of waters. This subject has been put on a systematic basis and applied to the problems of pasture establishment on difficult heavy soils of the Riverina plain of south-east Australia. Many of the soils are sodic, and the first limitation to pasture production is the very poor plant emergence frequently obtained after sowing. Instead of the conventional approach to reclamation of such soils requiring about 2½ tons of gypsum per acre to replace by calcium most

of the exchangeable sodium in the surface three inches of soil only one quarter of a ton per acre is used, dissolved in only the first irrigation after sowing. This allows emergence of a high proportion of seedlings. Once established, ameliorative processes continue in the well-known manner associated with pastures. A simple test to determine whether a particular soil will respond to gypsum treatment of this sort, and a simple gypsum dissolving machine have been described.

Another recent Australian experience has been that small areas of badly salt-effected lands may be reclaimed for pasture production by a rapid, cheap and simple method if conditions are such that clay soils may be drained vertically by relief of upward water pressure by pumping from an underlying aquifer. The method is applicable where pressure water will rise, in a small-diametor bore penetrating to the aquifer, to such a level that it can be disposed of by pumping with a centrifugal pump. Ponding of water on the surface before and during pumping facilitates a substantial degree of leaching under these conditions. An area which in 1960 carried no vegetation has since treatment of this sort grown millet followed by successful perennial pasture. Pumping has not been necessary since 1960, when the total cost per acre was only that of 16 gallons of petrol.

Other Australian experience which might be helpful elsewhere is (a) that salt damage to citrus leaves may occur with water containing less than 290 parts per million of dissolved salts, when applied through intermittent rotating sprinklers at low water application rate and under strong evaporation and (b) that it is possible to avoid the many difficulties in field testing of salt tolerances of plants by a rapid test under glasshouse conditions.

The wide literature on this complex subject has expanded notably since 1957 by the activities of international organization. Appropriate selections are being assembled by U.N.E.S.C.O. and F.A.O. in an International Sourcebook. In the meantime, means to avert salt problems are known for a wide range of conditions, but the time for oversimplified or casual approaches is past. The chief need is for those concerned with the selection of lands and waters for irrigation, and those administering irrigation projects, to be aware of the broad outlines of recent scientific and engineering advances in this field, and to ensure that an appropriate integration of the skills of the engineer, economist and scientist, including the soil chemist, water analyst, agronomist, plant physiologist and hydrogeologist, is brought to bear on salt problems in irrigation.



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